AI Assignment 1 (2024)
Report

Ravi Kumar Saxena
P23CS0006

1. To solve this problem I design a **Heuristic Function** that has following features
   - It should be **Admissible** as we want graph based search
   - It should minimize the number of expanded nodes to reduce computation.
   - heuristic is based on the Manhattan distance
   - Enhanced with specific penalties for costly directions, repeated movements, and proximity to barriers.
   - This approach ensures that the A* algorithm can effectively guide the agent to the goal while minimizing the number of expanded nodes and achieving the lowest path cost.

2. Heuristic Components:

- **Weighted Manhattan Distance**: Since the movement is constrained to vertical and horizontal directions, the Manhattan distance serves as a base heuristic. However, the movement costs differ for each direction (left, right, up, down). Thus, we apply different weights:

  Weighted Manhattan distance = abs(x1−x2)×8+abs(y1−y2)×10

- **Direction Bias**: Since some directions are cheaper than others (left and up are cheaper than right and down), we introduce a bias based on whether the current movement is in a direction that incurs a high or low cost:
  1. Moving left (cost 1) is favorable, so we reduce the heuristic.
  2. Moving right (cost 8) and down (cost 10) are penalized as they are costly.
- **Repeat Move Penalty**: To prevent the agent from repeatedly taking the same direction (which incurs a penalty), we apply an additional penalty if the current move direction is the same as the previous one:

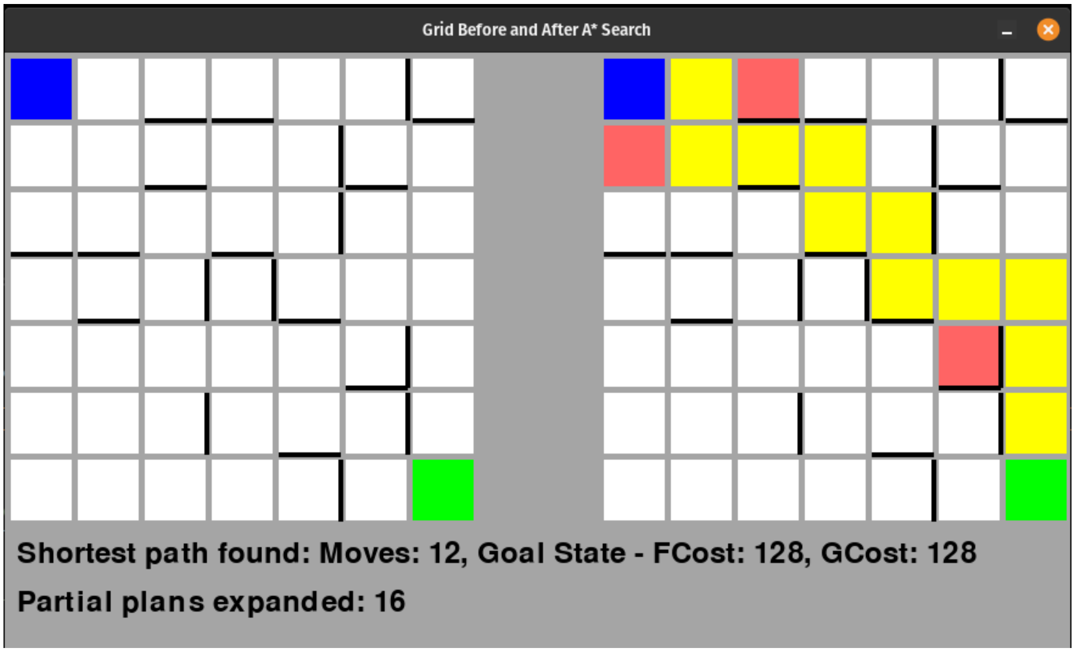
  Repeat penalty=5 if the current move is the same as the previous move

- **Barrier Penalty**: To avoid expanding nodes near barriers, a penalty is applied if the agent is adjacent to a barrier:

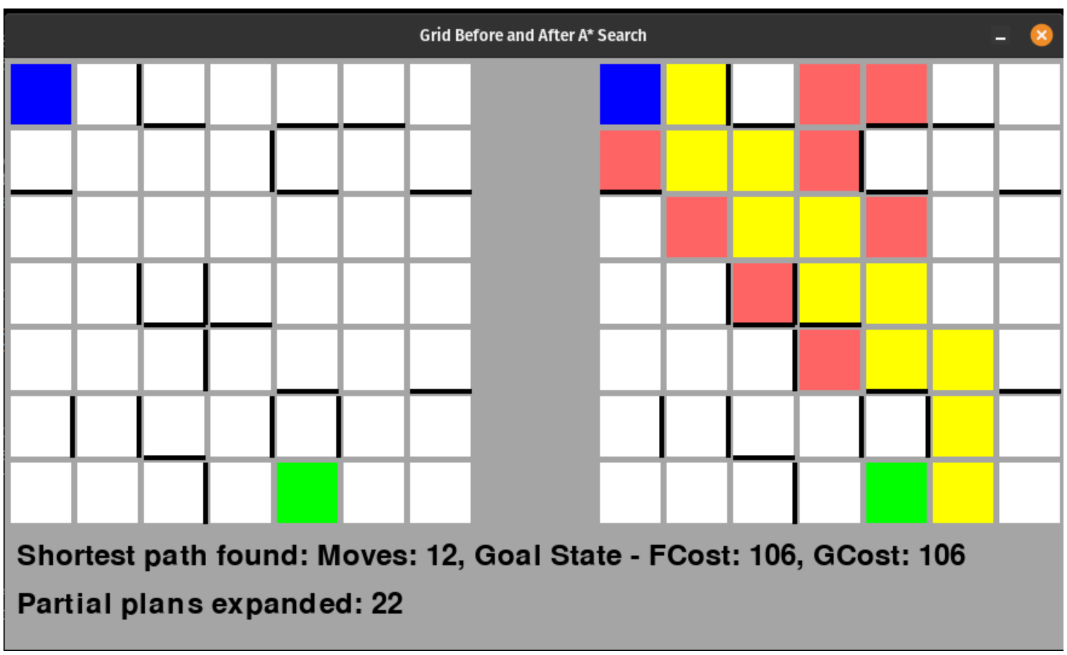
  Barrier penalty=10 for each barrier within one step from the agent's position.

3. Experiments & Results:-

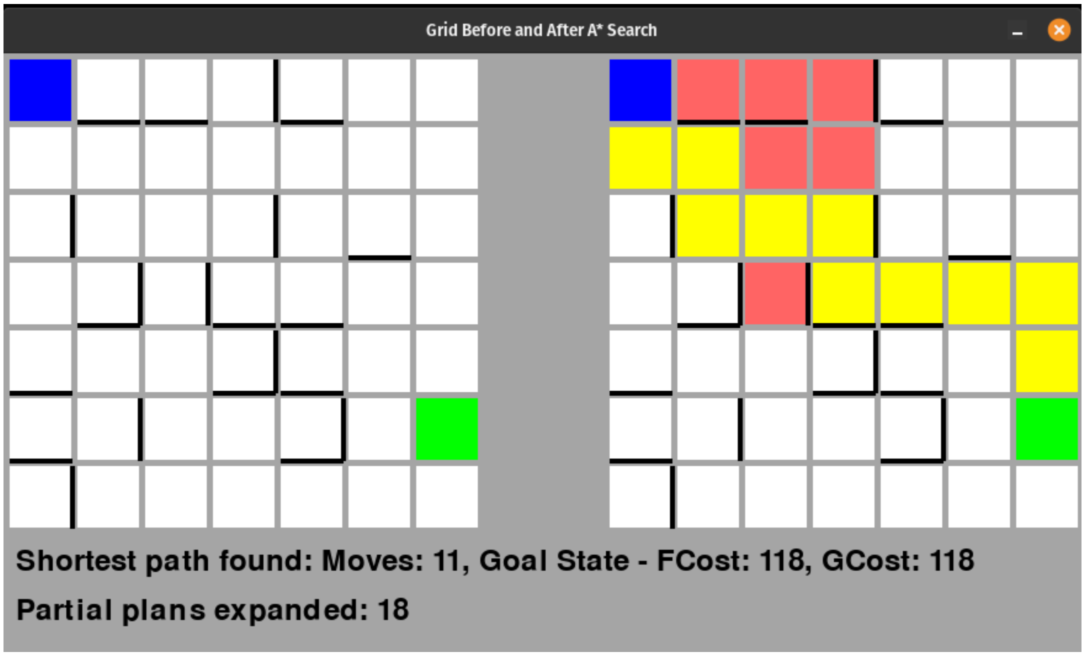
1. For grid=7x7 and Goal_state=(6,6)   Start_stae=(0,0)



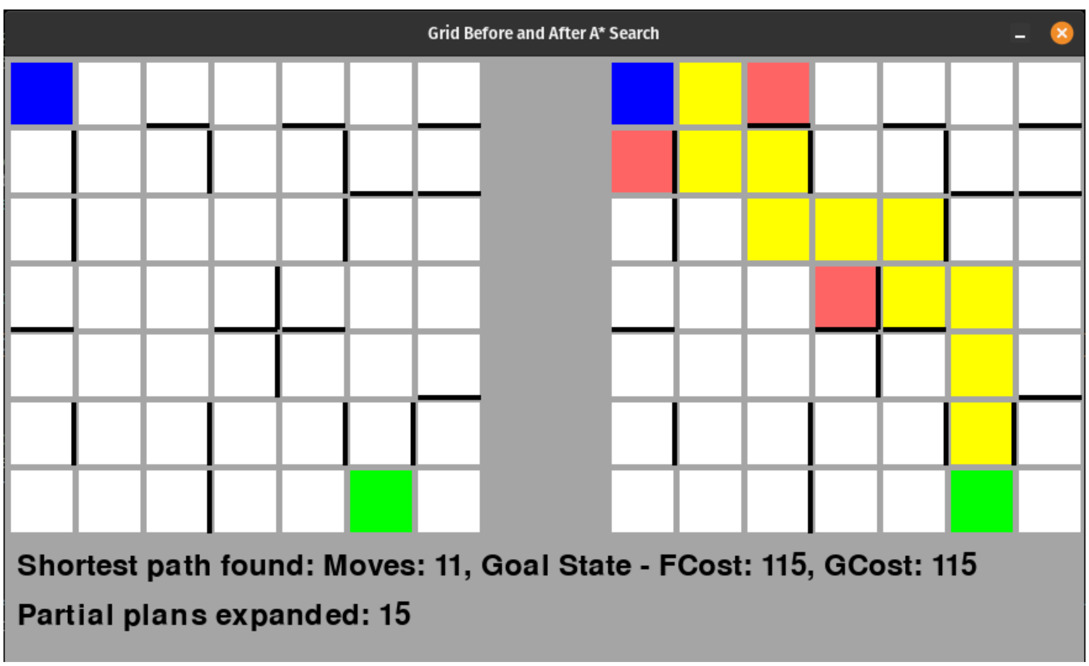
2. For grid=7x7 and Goal_state=(6,4)   Start_stae=(0,0)



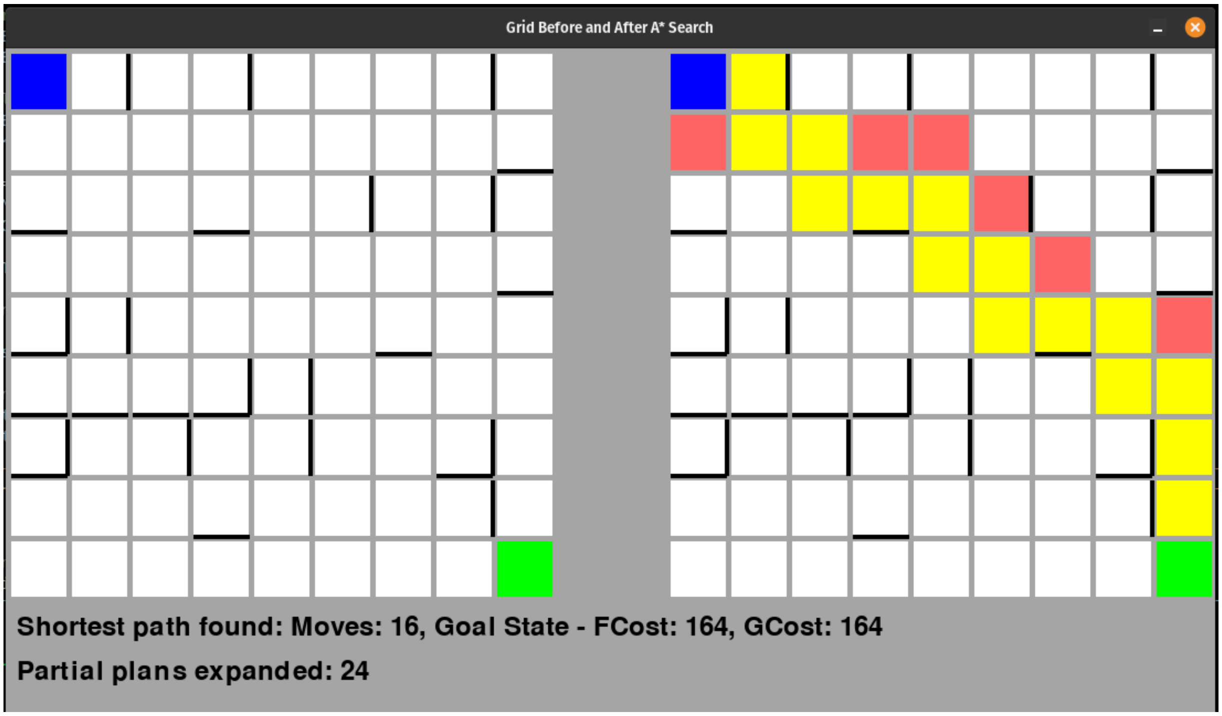
3. For grid=7x7 and Goal_state=(5,6) Start_stae=(0,0)



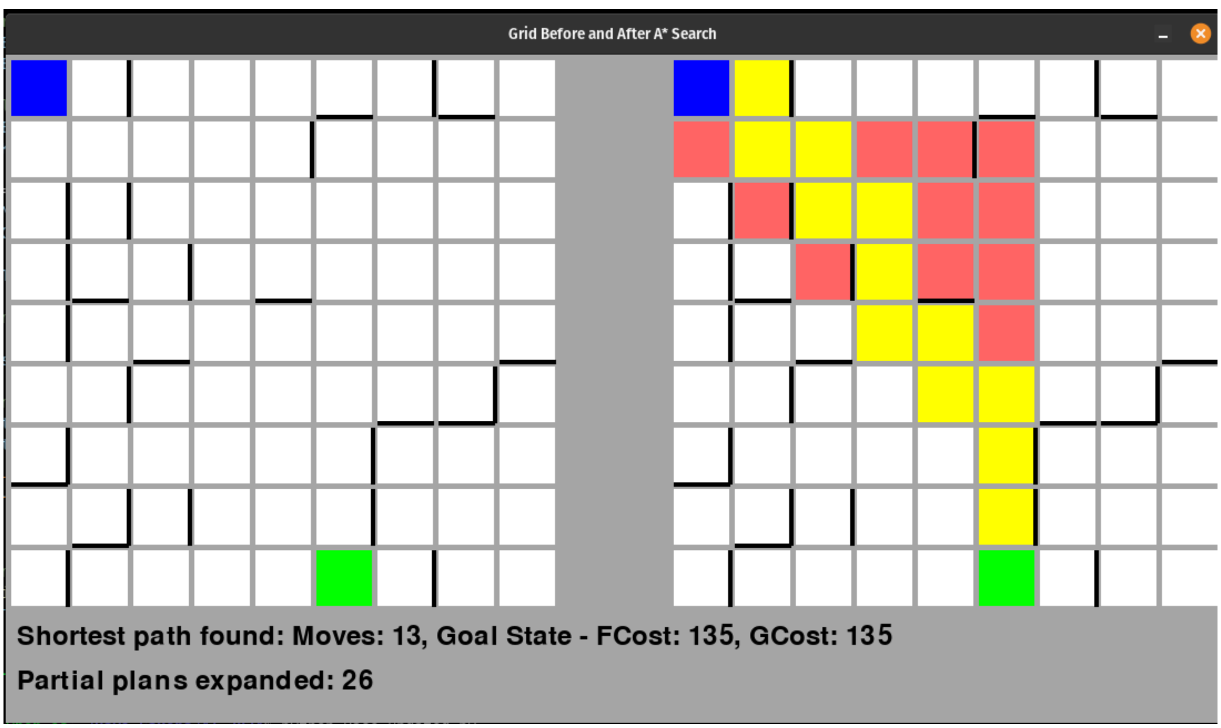
4. For grid=7x7 and Goal_state=(6,5) Start_stae=(0,0)



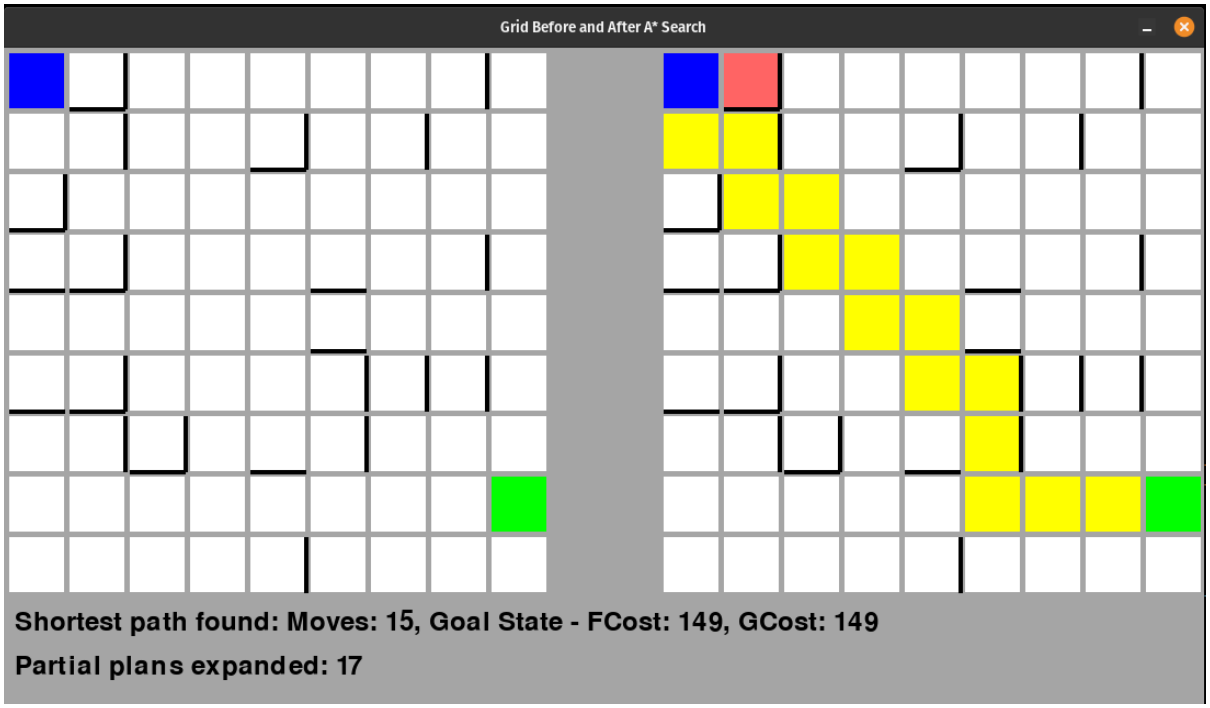
5. For grid=9x9 and Goal_state=(8,8) Start_stae=(0,0)



6. For grid=9x9 and Goal_state=(8,5) Start_stae=(0,0)



7. **For grid=9x9 and Goal_state=(7,8)   Start_stae=(0,0)**



And many more……..

4. References

- Foead, D., Ghifari, A., Kusuma, M. B., Hanafiah, N., & Gunawan, E. (2021). *A Systematic Literature Review of A* Pathfinding. Procedia Computer Science, 179, 507–514.*